

## **COUPP-0.1 fluid drain procedure**

COUPP-0.1 must be cleared of its fluids one at a time, with each liquid having its own drain procedure. They are described below in the order in which they should be performed.

### **C3F8 DRAIN PROCEDURE**

1. Set NESLAB chiller to 40°C. Allow the chamber to warm up. Make sure hydraulic system is pressurized. Set PR-001 to approximately 50psi and expand the chamber.
2. Close all bubble chamber valves.
3. The C3F8 storage vessel or transfer line should be equipped with a pressure gauge. Attach a vacuum pump to the storage vessel transfer line and evacuate the vessel and transfer line. Close the vessel's transfer line valve and switch off the vacuum pump. Ensure that the storage vessel has no leaks by monitoring the vacuum.
4. Set the C3F8 storage vessel in an ice water bath and set the bath upon a scale. Allow the vessel to cool down. Attach the transfer line from the storage vessel to MV-012.
5. Expand the bubble chamber.
6. Slowly open MV-012. Monitor pressure in transfer line. It should first increase to approximately the vapor pressure of C3F8 at 40°C and thereafter slowly decline.
7. Allow C3F8 to condense in storage vessel. This may take a while. Monitor the pressure in the bubble chamber and the bellows position. As the bellows compresses, lower the hydraulic system pressure via PR-001.
8. Once the pressure stabilizes, C3F8 drain is complete. Close MV-012 and the transfer line valve. Disconnect the transfer line from MV-012. Crack MV-012 to bring the bubble chamber to atmospheric pressure, then close it again.

### **WATER BATH DRAIN PROCEDURE**

To drain water from the water bath, disable and disconnect the NESLAB chiller, and drain the water bath through the fill line.

## **HYDRAULIC FLUID DRAIN PROCEDURE**

1. Ensure that C3F8 has been drained from the bubble chamber. If C3F8 is still present in the bubble chamber, draining the hydraulic system will result in damage to the bellows.
2. Add mineral oil to the reservoir so the pickup on the bottom is not open to air.
3. Open MV-012 to vent the bubble chamber.
4. Open MV-004, MV-005, MV-006, MV-014, MV-016, MV-017, and MV-019 to vent the hydraulic system. Vent the accumulators. Ensure that no air is allowed to enter the system by keeping a healthy level of oil in the reservoir.
5. Close MV-016 and MV-006.
6. Open EV-001 and close EV-002 and EV-003.
7. Remove PT-005 (Dytran). Be prepared with towels to catch any mineral oil which may leak out.
8. Attach a vacuum pump to MV-019. Use the pump to suck mineral oil from the hydraulic system. When a continuous stream of bubbles enters the mineral oil reservoir from below, close EV-001.
9. Open EV-002 to suck the remaining oil out from the high-pressure lines. When the pump is pulling air again, close EV-002 and MV-004.
10. Open MV-006 and EV-003 to clear oil from the low-pressure lines and accumulator. When the pump is pulling air again, close EV-003 and MV-006.
11. Some mineral oil may remain in the pressure chamber. This may be cleared out using a hose, a vacuum pump, and a sample bottle, or by simply disassembling the pressure chamber and catching the excess mineral oil in the water bath vessel.

## **BUBBLE CHAMBER WATER DRAIN PROCEDURE**

To drain the water from the bubble chamber, either remove the vessel and pour the water out, or boil it out using a vacuum pump on MV-012 and a heat gun on the vessel body.